

18 Tuttle Creek Lake

18.1 General Background

Tuttle Creek Lake was impounded in 1962 and reached full pool on 29 April 1963. The primary water quality threats to Tuttle Creek Lake and its' watershed are sedimentation, herbicides, nutrients, and bacterial contamination. The lake is listed on Kansas's 303(d) list for water quality impairment due to eutrophication, atrazine, alachlor, pH, copper, silt, and *E. coli* (inflows). The atrazine TMDL was approved in 2005 by KDHE, while the other TMDLs were implemented in 1999. A watershed restoration and protection strategy (WRAPS) group is forming during 2006. The goals and objectives of the WRAPS group will be to protect Tuttle Creek Lake and ultimately remove it from the 303(d) list of impaired waters.

18.1.1 Location



Tuttle Creek Lake is located 8 km (5 miles) north of Manhattan, Kansas. The dam is located on the Big Blue River at river km 16 (river mile 10) above the confluence with the Kansas River. The watershed flows south from Nebraska and includes counties of . Historic water quality sample sites at Tuttle Creek Lake include 3 lake, 1 outflow, and 2 inflow (Figure 18.1).

Figure 18.1. Tuttle Creek Lake area map with sample site locations.

18.1.2 Authorized Purposes: Flood control, recreation, navigation, water quality improvement, and fish and wildlife management.

18.1.3 Lake and Watershed Data

Pools	Surface Elevation (ft. above m.s.l.)	Current Capacity (1000 AF)	Surface Area (A)	Shoreline (miles)
Flood Control	1,136.0	1,903.4	53,600	112
Multipurpose	1,075.0	299.5	14,000	
Total		2,202.9		

Total watershed area: 9,600 sq miles (6,144,00 A)

Watershed ratio: 114.63 FC / 438.86 MP

Average Annual Inflow: 1,860,074 acre-feet

Average Annual outflow: 000 acre-feet

Average flushing rate:

Sediment inflow (measured): 216,145 acre-feet (1962 – 2000)

18.2 2005 Activities

Tuttle Creek Lake was categorized at an 'intensive' lake during 2005, thus samples were collected from two inflow (Site 30 and 32), 3 lake (Sites 3, 8 & 11), and a single outflow (Site 27); (see Figure 18.1 for specific locations). Sample collections occurred from May through September 2005, with monthly vertical profiles (temperature, DO, pH, conductivity, and turbidity) recorded at the three lake sites. Tuttle Creek Lake staff (OF-TC) providing field sampling assistance during 2005 included Gene Scherer and Paul Weidhaas. Brian McNulty, OF-TC Operations Manager, provided insight and background regarding Tuttle Creek Lake.

18.3 2005 Data

Comparative historic data consists of monthly (April – September) data collected from 1996 through 2005.

18.3.1 Inflow

Inflow samples were collected from two watershed sites located on the Big Blue River at Highway 77 (Site 30) and Black Vermillion River (Site 32). Historically, water quality parameters are most variable at these sites due to influences of runoff events and climatic variations within the watershed.

18.3.2 Lake

Tuttle Creek Lake holds the distinction of having the highest median concentration for total nitrogen (TN) and second highest for total phosphorus (TP) within the district. Therefore, the influx of such large quantities of nutrients leads to a very eutrophic lake. Median concentrations range from 2.3 – 2.6 mg/L within the lake (Sites 3, 8 & 11) , 1.9 –

2.7 mg/L at the inflows (Sites 30 and 32, respectively), and 2.3 mg/L in the outfall (Site 27)(Figure 18.2). These concentrations exceed EPA's proposed ecoregional nutrient criteria value of 0.36 mg/L TN. Monthly and annual variability in TN is evident at all sites within the watershed, as depicted in Figure 18.3 for Site 30.

Surface water sample median TP concentrations collected from 1996 through 2005 range from 0.325 – 0.33 mg/L at lake sites, 0.3 – 0.56 mg/L at the inflows (Sites 32 and 30, respectively), and 0.25 mg/L in the outfall (Site 27)(Figure 18.4). These median values exceed EPA's proposed ecoregional nutrient criteria value of 0.02 mg/L TP.

The ratio of TN:TP can be used as a surrogate to determine the dominant algal community within a waterbody. Ratios $\geq 20:1$ are indicative of desirable algal communities, whereas ratios $\leq 12:1$ are indicative of bloom-forming cyanobacteria (blue green algae). As would be expected, there is high monthly and annual variability in the TN:TP ratio at all sites. Median TN:TP ratios at all three lake sites are < 12 , indicating the lake is at risk for cyanobacteria blooms (Figure 18.5). High turbidity rates may moderate the expected high risk during wet inflow years.

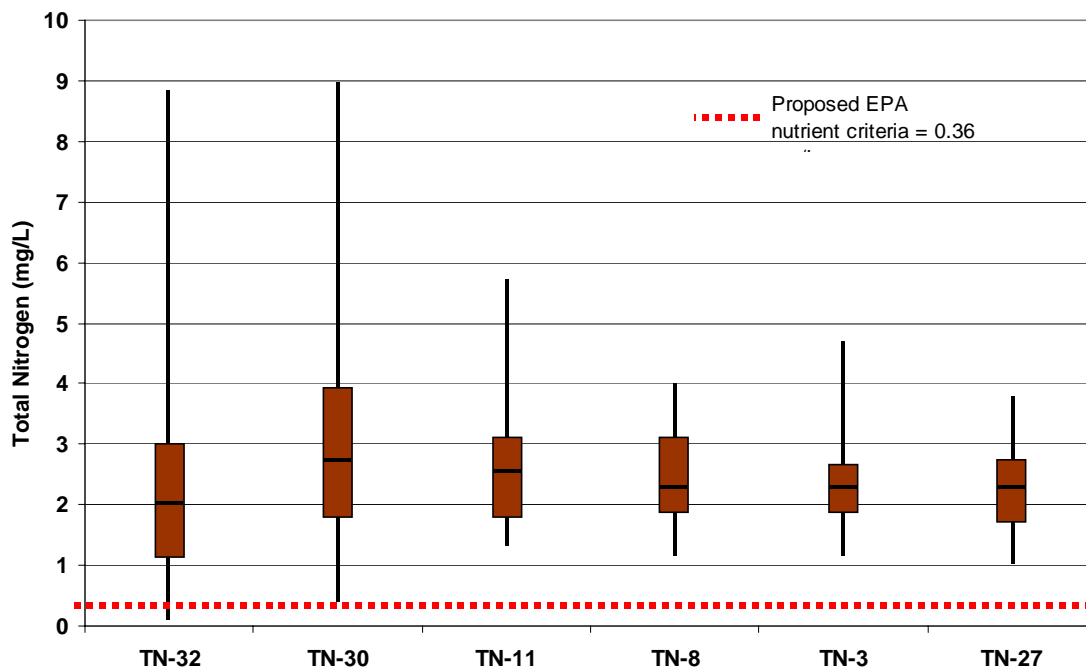


Figure 18.2. Box plots of surface water sample total nitrogen concentrations measured by site from 1996 through 2005 at Tuttle Creek Lake.

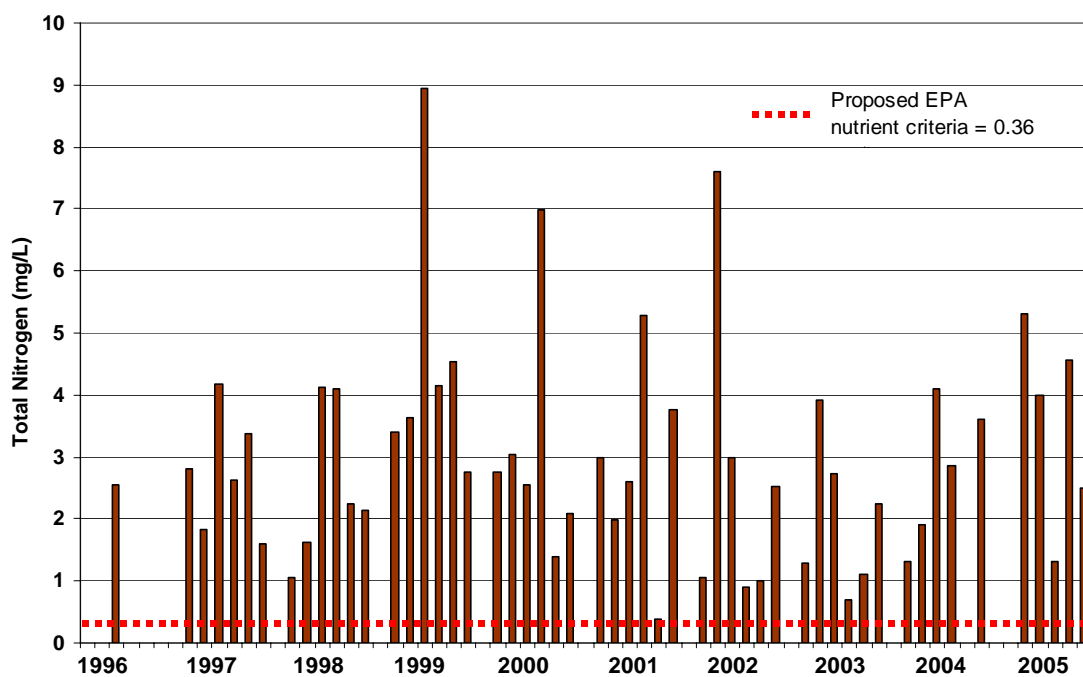


Figure 18.3. Graph of surface water sample total nitrogen concentrations by sample at Tuttle Creek Site 30 (Big Blue River) from 1996 through 2005.

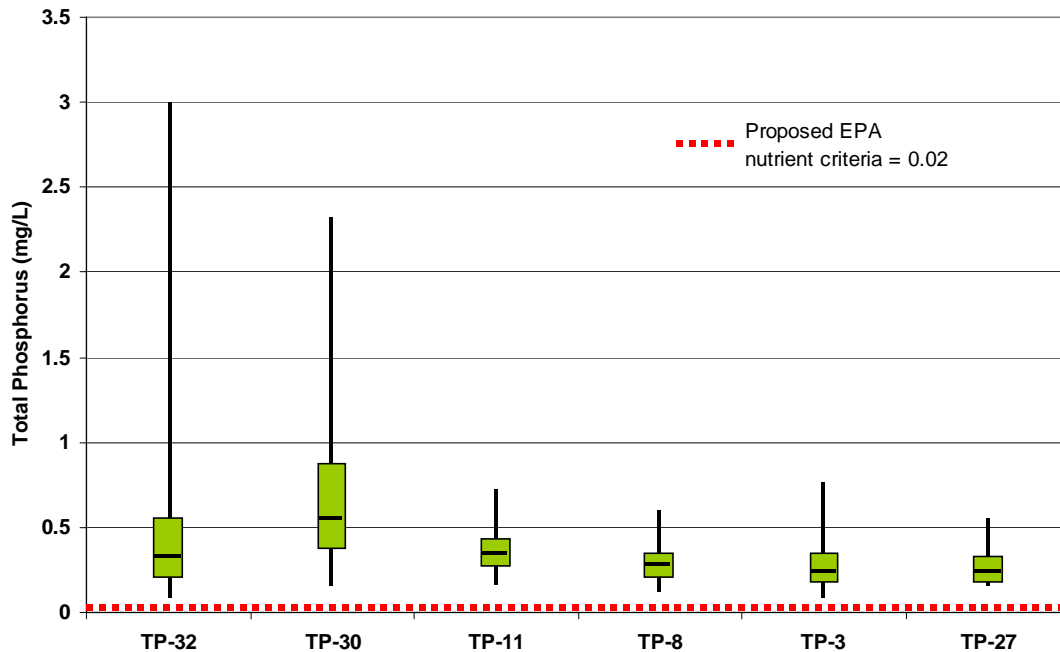


Figure 18.4. Box plots of surface water sample total phosphorus concentrations by site from 1996 through 2005 at Tuttle Creek Lake.

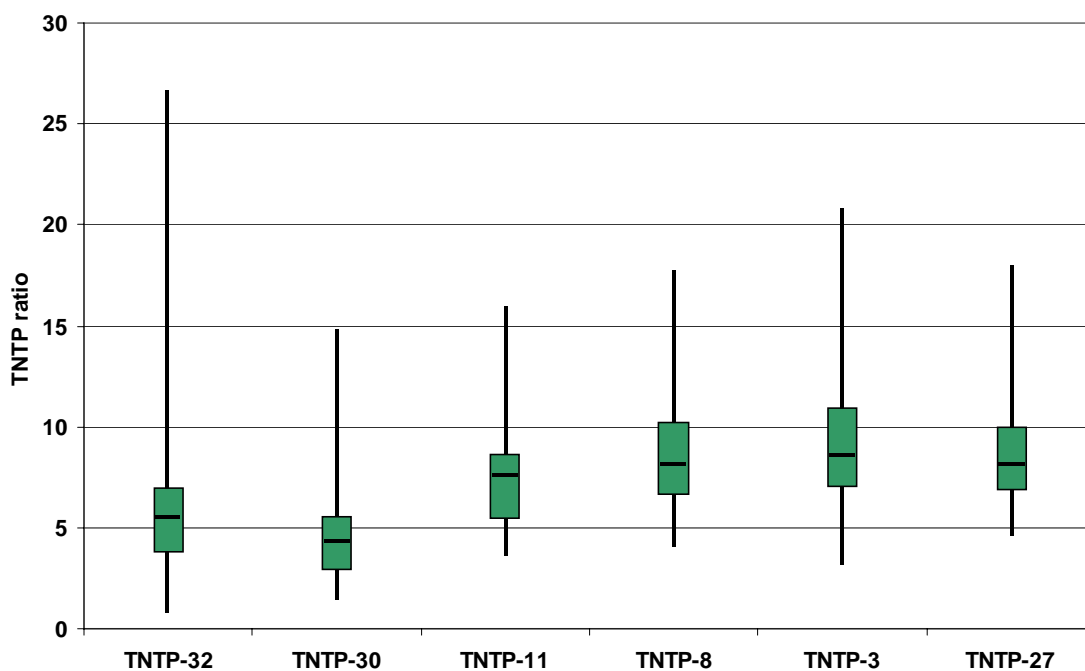


Figure 18.5. Box plots of total nitrogen : total phosphorus (TN : TP) by site from 1996 through 2005 at Tuttle Creek Lake.

Secchi depth measured from June through September varied by site. Very limited water clarity was measured at all lake sites, with some improvements in water clarity moving from uplake (Site 11; range = 0.09 – 0.12 m) to down-lake (Site 3; range = 0.37 – 0.43 m). Mean chlorophyll a concentrations ranged from 9 to 14 ug/L during July and August 2005. It is important to note that chlorophyll a concentrations were 3 – 10x greater at Site 11 (up-lake) versus Site 3 (tower).

Concentrations of the herbicides atrazine and alachlor have been significant enough to warrant listing of the waters on the states 303d list. Median atrazine concentrations (1.1 – 1.3 ug/L) are less than EPA's drinking water maximum contaminant level (MCL) of 3 ug/L (Figure 18.6). However, individual samples measured from 1996 through 2005 are significant enough to exceed the MCL. Figure 18.7 depicts the individual sample concentrations measured by date at Site 30 (Big Blue River) inflow. Median alachlor concentrations from surface water samples range from 1.1 – 1.3 ug/L, which are less than EPA's drinking water MCL of 2 ug/L (Figure 18.7).

Total iron exceeded EPA's Drinking Water Standard of Secondary Maximum Contaminant Levels (SMCL) of 300 ug/L from surface samples collected during August at all three lake sites (1057 – 5269 ug/L), inflows (2071 – 33,624 ug/L) and outflow (1091 ug/L). The extremely elevated levels on the Big Blue River at Blue Rapids is a concern to the lake. Implications are directed at drinking water facilities related to taste and staining issues. In addition, surface samples collected during August exceeded EPA's SMCL for manganese (50 ug/L) at the inflow sites, upper lake and mid-lake sites. Sample concentrations ranged from 60 – 718 ug/L, with the highest concentrations measured at Site 30 (Big Blue River). Implications are directed at drinking water facilities due to taste and stain issues. Lead was also exceeded at Site 30 (20 ug/L).

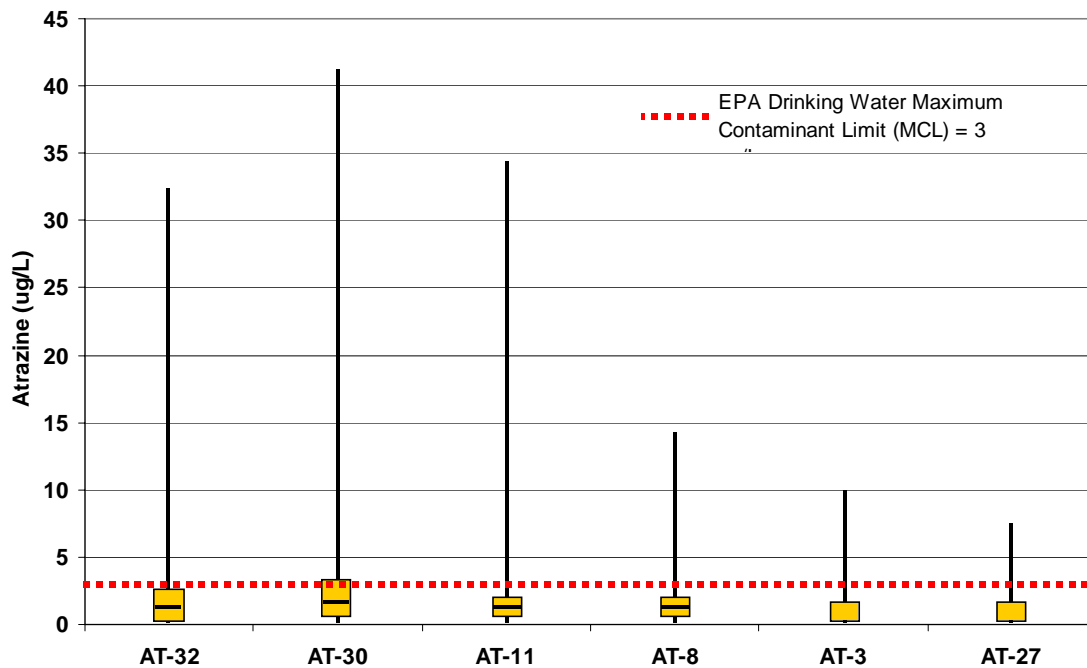


Figure 18.6. Box plots of surface water sample atrazine concentrations measured by site from 1996 through 2005 at Tuttle Creek Lake.

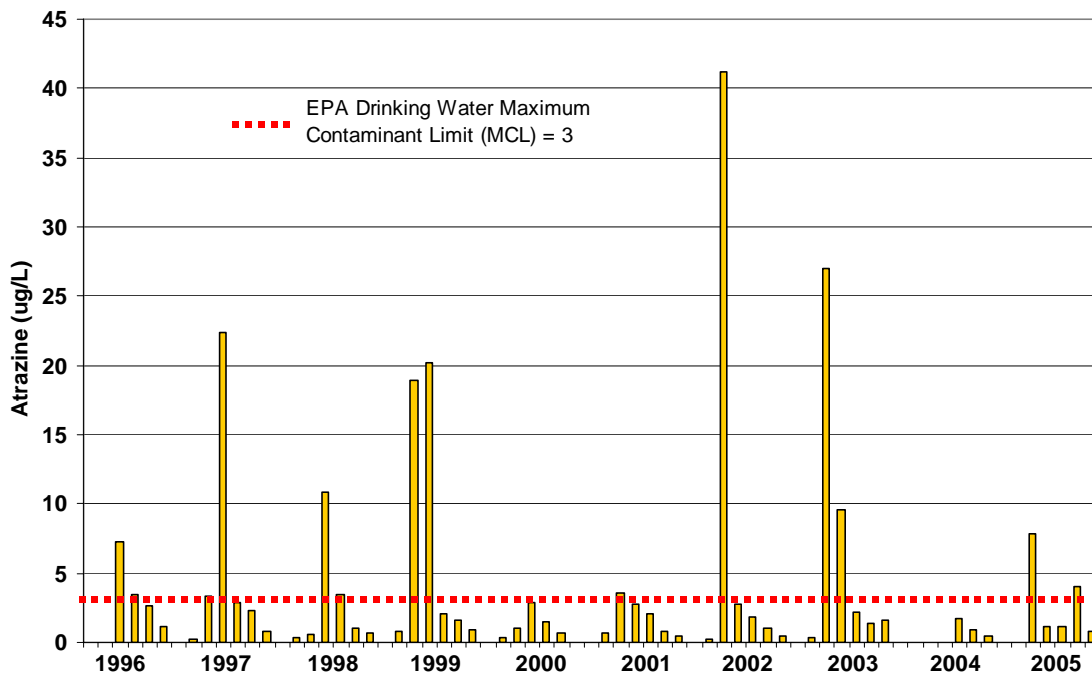


Figure 18.7. Atrazine concentrations from surface water samples by sample date collected at Site 30 (Big Blue River) inflow to Tuttle Creek Lake from 1996 through 2005.

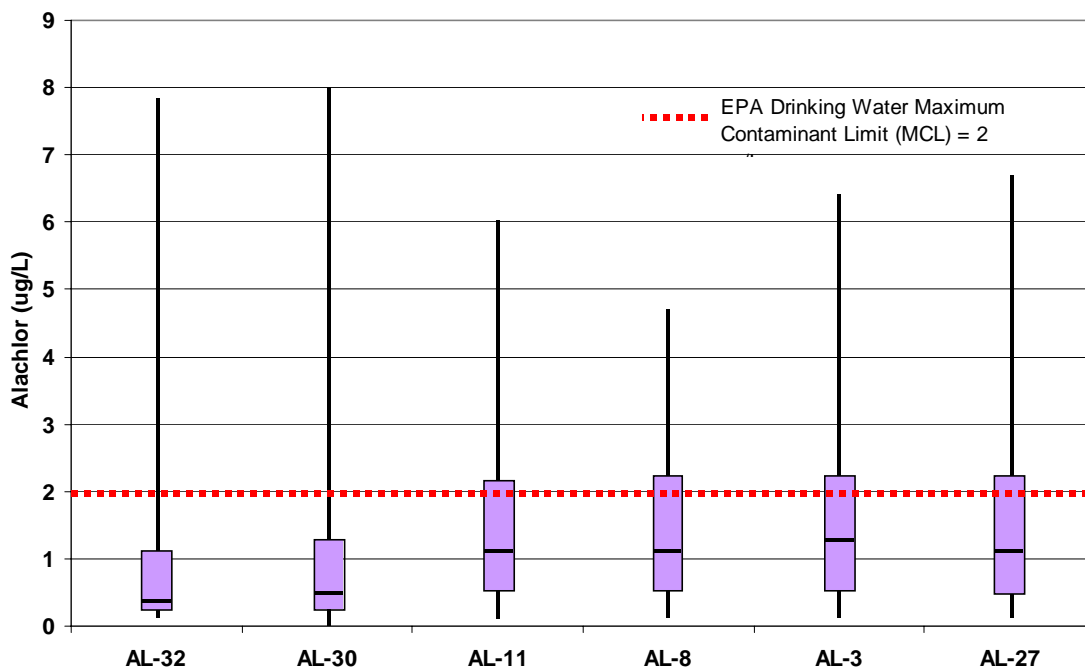


Figure 18.7. Box plots of surface water sample alachlor concentrations measured by site from 1996 through 2005 at Tuttle Creek Lake.

Vertical profiles were recorded during sample trips in June, July and September 2005. Parameters included temperature, dissolved oxygen, pH, conductivity, and turbidity. Based on these profiles, the lake was weakly stratified thermally during June and July, and destratified September (Figure 18.8). Chemical stratification was weak during June and July, while the lake was homogeneous during September.

18.3.3 Outflow

Outflow samples were collected during 2005 from the stilling basin (Site 27). This data is discussed in concert with lake specific sites above.

18.4 Future Activities and Recommendations

Sampling activities for 2006 will include transition from 'intensive' to 'ambient' monitoring from April through August, as well as conducting monthly vertical profiles at each of the three lake sites. As part of the bi-state EPA Targeted Watershed grant project (2006 – 2010) within the Tuttle Creek watershed, \$810K will be spent during the next 3 years to promote conservation agricultural practices and education programs related to water quality improvements. No-till farming and riparian buffer strips are two of the cost-effective conservation practices designed to reduce agricultural runoff. For our part, CENWK will continue to sample inflow sites monthly (April – September) for nutrients

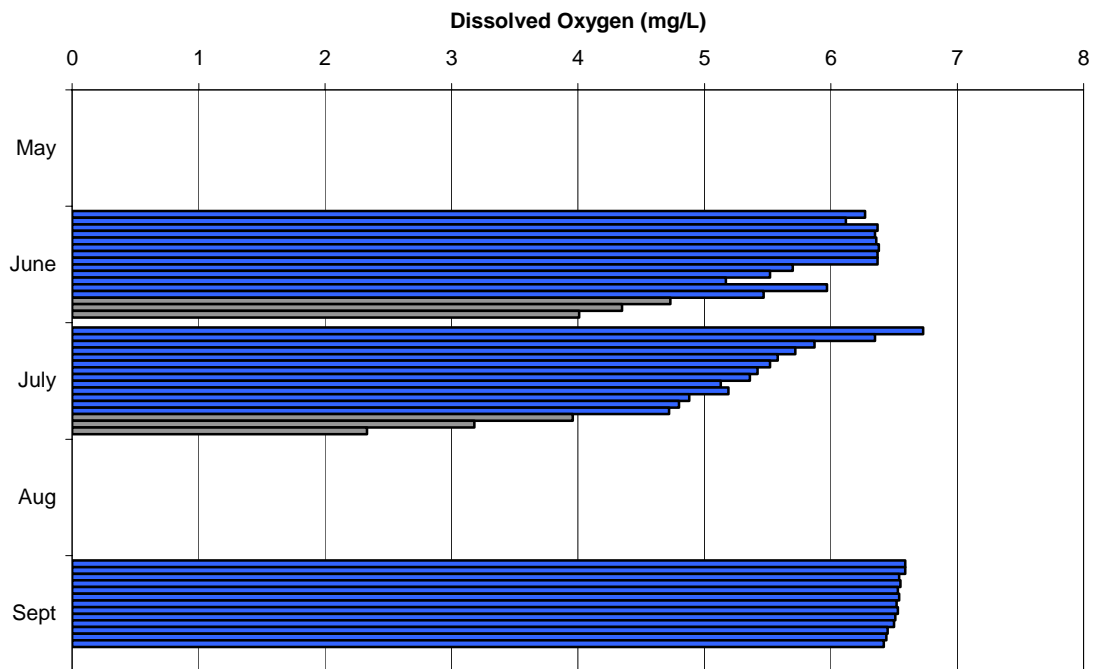
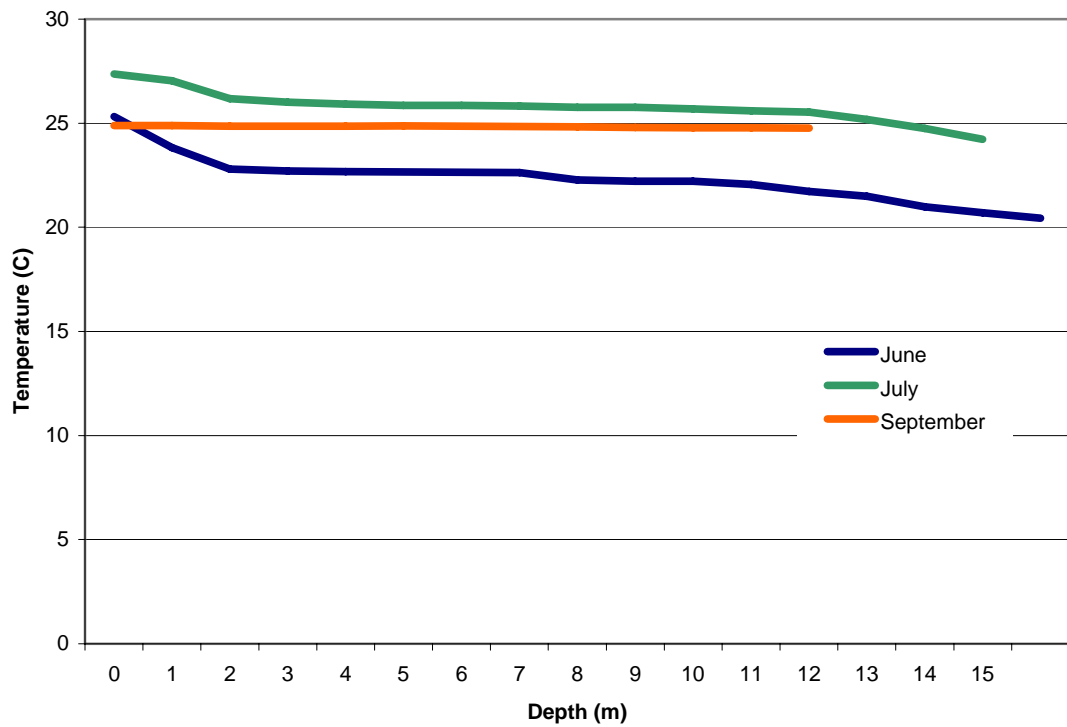


Figure 18.8. Dissolved oxygen concentration (mg/L) histogram and temperature (°C) plot from vertical profiles recorded at Site 3 (Tower) during June, July and September 2005 at Tuttle Creek Lake.

and herbicides. Communication and data sharing will continue with the forming WRAPS project. Monitoring and consultation regarding the projected 10-year dam modification project at Tuttle Creek will also continue during the next year.
